on piping, but it not clear which activity is most like the installations that the BCM2 developers had in mind when they included this cost.

The last group of cost items involves cutting and restoring asphalt, concrete, and sod. The cost of installing asphalt can be in the range of $7.50 to $9.00 per square foot (Means, p. 72), but it often runs considerably higher. The additional costs are associated with cutting the existing asphalt, and digging the trench. Based on job estimates that I have seen, the BCM2 model appears to underestimate the cost of cutting and restoring asphalt. The additional costs associated with working on asphalt may be reflected in the models estimate of the cost of installing conduit, $40 per foot. Because of the lack of documentation, it is hard to tell if this is a correct characterization.

BCM2 uses a value of $10.84 for cutting and restoring concrete. Means reports that the cost of two-inch thick asphaltic concrete for sidewalks and driveways is $5.70 per square *yard* (p. 71). The cost of cutting the concrete is approximately $1.47 per square foot (Means, p. 30). This data, along with an approximate $2.00 cost per foot for digging the trench, suggests that the BCM2 reported cost of $10.84 per foot is on the high side.

Finally, BCM2 reports a value of $2.06 for cutting and restoring sod. Means reports that the cost of sodding a thousand square foot area is approximately $400 (p.112). Sodding a thousand square feet is much different than patching up a small area that has been cut for installing cable. Consequently, I am unable to judge the reasonableness of the $2.06 value used in the BCM2.

Summary of Comparison Between BCM2 and Installation Costs Reported by Means

From the data that I am able to verify, I find the values in BCM2 to be generally reasonable. My greatest concern is that the estimate for cutting and restoring asphalt may be too low and the cost of plowing too high. However, the low value for asphalt may be due to the way the data are constructed. The model assumes that the cost of installing conduit is $40 per foot. This charge might be picking up the high reinstatement costs that I expect to see when asphalt is cut and repaired.

Implications for Costs Used in the Model

BCM2 uses a weighted cost for the different activities. Whereas I have found that the cost of the individual activities appear to be reasonable, while the composite numbers appear to be high, the weighting factors are probably incorrect. The weighting factors appear in the column head, "% of Activity." These values are difficult to validate, but since the weighted cost estimates do not comport with the prospective values reported by NET, I conclude that they are incorrect.

Future Method for Validating Cost Values

I have used NET's data to judge the reasonableness of the Benchmark's cable installation costs. Prospective cable cost data can be obtained from other LECs and may serve as a basis for judging the reasonableness of the models' values. The models' sponsors should be requested to provide the effective installation investment costs for different types of cables for each of a LEC's study areas.[47] The data should then be compared with the installation costs that can be derived from LEC's broad-gauge unit costs as explained on page 34.

When the comparison is made, no *a priori* assumption should be made regarding which value is correct if there is a difference. For example, if the model reports an installed cost per foot that is less than the value identified by the carrier, the difference could be due to the model's understatement of the economic cost-of-production that would be incurred by an efficient firm, or the values reported by the LEC could exceed the costs incurred by an efficient firm. The LEC may be inefficient or misallocating costs to its loop facilities. Where significant differences arise, the Joint Board will have to exercise its judgment concerning what constitutes a reasonable value.

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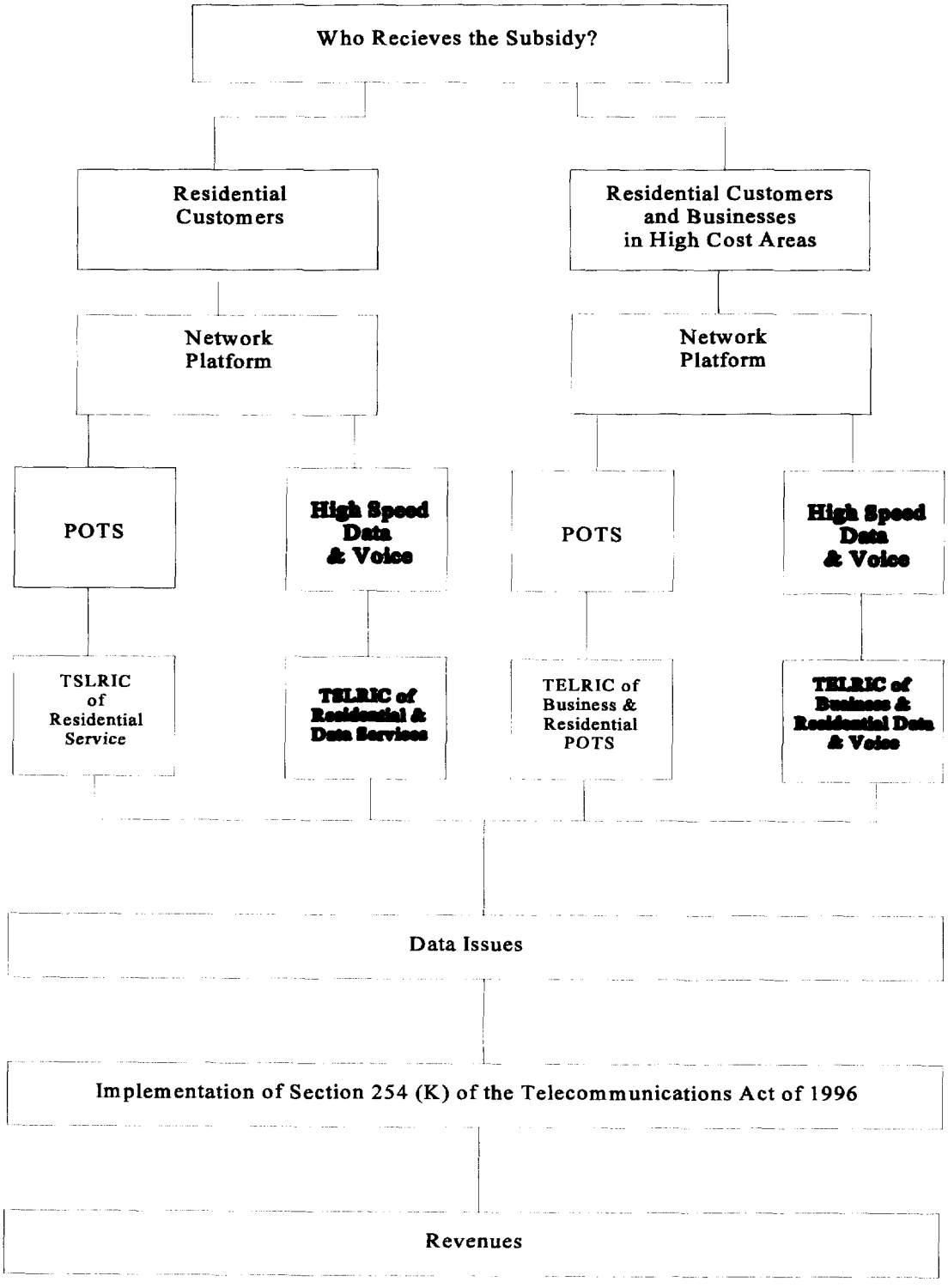
[47] The comparison should be done at the study area level, because a LEC's costs can vary greatly within a State. For example, in a 1985 cost study undertaken by New York Telephone, the Company found that the current cost per foot of installing a 100-pair aerial cable on Long Island was $6.11 per foot. In the more rural setting of western New York, the cost was $3.22 per foot for the same size cable. New York Telephone's response to New York Consumer Protection Board Request 280, Case No. 28978, May 24, 1985.

Where Do We Go From Here?

Considerable progress has been made in identifying the cost of providing universal service. BCM1 provided the Joint-Board with the first systematic study of how the cost of installing a loop varied depending on such geological parameters as the bedrock depth, bedrock hardness, soil type, and the depth of the water table.

The derivatives of BCM1, BCM2 and Hatfield 2.2.2 incorporate significant enhancements. However, before either model, or a hybrid cost model is adopted, I recommend that the Joint-Board address the series of issues identified in this section. The following diagram illustrates how I believe the assessment of the cost of providing universal service should be addressed:

Figure 2: What's Left to be Done



I. What is the Objective of the Universal Service Fund?

The costing tool should be designed to provide the information that is needed to implement the policies that are consistent with the 1996 Telecommunications Act. The Joint Board must determine whether the fund will be used to subsidize only residential customers, or if it should be expanded to recover a portion of the cost of serving business customers in high-cost areas. If the Joint Board concludes that both groups should receive subsidies, then the fund should be designed to measure the shared and the direct cost of providing service to both sets of customers. This is equivalent to measuring the total element long run incremental cost-of-service (TELRIC). If the Joint Board concludes that the Act is designed to provide support only to residential customers, then the cost tool should measure only the incremental cost of providing residential services. This is equivalent to measuring the total service long run incremental cost-of-service (TSLRIC).

II. Network Platform

There is an important distinction between basic local telephone service and the local common exchange plant. Basic local service is simply voice telephone connections within a specifically defined local area. Local exchange plant is comprised of those facilities that are physically located within the given area, but that are used to supply both basic local and premium services.

The loop and port on the switch are not used only for exchange service. These facilities are a common input for the provision of all switched service. Thus, local exchange facilities, generally referred to in the industry as "local exchange plant," are an essential input to almost all services. So, local exchange plant is used as a common facility to supply "basic" service—as well as an increasing variety of "premium" services.

Local exchange facilities are used by the different kinds of services that are provided over them. As such, the engineering design standards, the functional characteristics of the facilities, and the investment and expenses incurred, are determined by the variety of functions for which those facilities will be used. This

means that the costs of the common facilities are caused by the multiple services and, therefore, the recovery of the costs must be shared among the services provided over them. The principle that the cost-causing services should be responsible for recovering the costs associated with their demand[48] requires that the recovery of the local exchange plant costs be based on the traffic and engineering parameters of all the services that share the facilities, rather than just recovering all of the common and joint costs from local exchange services.

BCM2 only partially reflects the engineering assumptions that are driven by the LEC's development of integrated service digital networks (ISDN). In order to maintain transmission integrity for high-speed data, the maximum copper distance on a loop must be in the range of 12,000 to 18,000 feet. In the BCM2, the maximum copper distribution distance is set at a default level of 12,000 feet.[49] In a voice-only network, the copper feeder and the distribution distances can be considerably greater than 18,000 feet. Therefore, compliance with the ISDN standards necessitates the design of a network that does not minimize the cost of providing voice service.

The Joint Board should determine whether the models should be designed to meet the resistance design standards for voice or ISDN. If the latter standard is adopted, this will raise the cost of providing universal service; It will, in fact, essentially redefine the nature of universal service. Rather than limiting universal service to ordinary voice communications, it would be expanded under §254(c)(1) to include LECs provisioning their networks to provide at least 64 kbs transmission speeds to each household in America.

For a number of years, the ISDN standard has guided the engineering of loops. If the intent of the universal service cost modeling exercise is to obtain an estimate of the LECs' prospective costs, the ISDN standard should be built into the models.

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[48] Mountain States Telephone & Telegraph, 82 PUR4th 64, 82 (1987).

[49] "Benchmark Cost Model 2: Methodology," n.d., n.a., p. 3.

If the cost models are designed to measure the cost-of-service on an ISDN network, it would be inappropriate to consider only the revenue from traditional exchange services. Since the provision of new services is driving the design of the network, the revenues from ISDN and other enhanced products should be included in the analysis. To do otherwise would involve a mismatch between the cost drivers, the provision of new services, and the profitability of universal service products.

If the policy objective is to fund the provision of voice only services, then the ISDN standards should not be built into the models.

III. Data Issues

A number of data issues have been raised in this paper. I have relied on publicly available information to evaluate the reasonableness of the network's largest cost; the cables that link customers to the wire center. The sponsors should be encouraged either to adopt the values presented in this paper, or they should provide better documentation as to why their current or some other alternative values should be used. The Joint Board should also provide guidance on the following issues:

A. Depreciation

Depreciation rates used by the industry are very much a function of the services which are available currently, or are likely to be introduced in the foreseeable future. For example, the LECs' interest in providing broadband services has encouraged them to shorten the remaining life of copper cables. The provision of CLASS services compelled the local exchange companies to replace modules in both the DMS-100 and #5ESS switching machines because they were unable to provide these new enhanced services; However, they were quite capable of providing voice services.

For example, New England Telephone's 1993 Depreciation Rate Study for Maine contains a poignant description of the factors that are driving the reduction in the life of this class of plant:

> At the core of the evolution to broadband is the demand to transport data, image and video information. Today's digital

> switches are designed to handle up to 64 Kb/s of bandwidth. However, new and emerging data services such as computer-based imaging and multimedia communications require much higher bandwidths. In order to handle these high-capacity communications, the existing digital switching equipment must be upgraded or replaced [emphasis added]. These data services will require an integrated broadband architecture which includes Metropolitan Area Networks (MANs), Broadband ISDN/Asynchronous Transfer Mode (BISDN/ATM) and features planned for the Photonic switch of the future.
>
> Providing the capability of bandwidth on demand through the adoption of BISDN (broadband integrated services digital network) along with Synchronous Optical NETwork (SONET) transmission standards will eventually cause the replacement of the majority of today's digital switching equipment, including line cards and networks, and eventually cause wholesale switch replacements. The evolution to broadband switching is expected to begin soon and complete over a shortened time frame as compared to previous technologies.[50]

These two paragraphs from NET's Depreciation Rate Study exemplify the overall driving force behind the shortened, expected life of digital switching. NET believes that the switches need to be replaced in order to enhance its marketing of high-speed data and video services. These services, rather than exchange voice-grade service, are responsible for the shortened life, and hence, the increased depreciation expenses. If not for the increased effort to market these new services, there would be a reduced need to accelerate the retirement of digital switches. Therefore, for the universal service study, the Joint-Board should either adopt lives that are appropriate for a voice-only network, or include in the profitability analysis the earnings from these new services. If the cost impact of the new services is to be reflected in the cost studies' depreciation rates, the earnings should be as well.

NET, like other LECs, expects a continued need to upgrade the processor of the switching machines: "These [core processor] upgrades are continuing to occur and are

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[50] NET's 1993 Depreciation Rate Study for Maine, filed December 8, 1992, section Electronic Digital Switch, p.13-14.

required to increase overall capacity of the digital switch Custom Calling Services on a per line basis and the implementation of new digital only features under the service mark of NYNEX Pathway Services.[51] [emphasis added]

Signaling System Seven (SS7) was installed to a large degree to meet the needs of the interexchange carriers, and to allow the LECs to offer new, enhanced services. NET's depreciation rate study points out that "Since the 1990 (depreciation) Study, the level of retirements...have increased significantly...due to the accelerated deployment of SS7 and CLASS features."[52] NET adds that "SS7 requires major switch replacements of earlier trunking units, extensive modification to current trunking modules and entire network fabric change-outs to support higher transmission rates. These retirements and replacements represent a significant portion of the switch investment."[53]

Explaining the need to increase the depreciation rate for the #5ESS switching machine and remotes, NET pointed out that "as the switches upgrade to the higher levels of more complicated software generic programs that offer CLASS, AIN (advanced intelligent network), ACD capabilities, major change-outs are occurring within the switch. The software upgrades not only provide CLASS, AIN, etc. capacity, but are mandatory requirements for 800 Numbers Portability, CIC Code Expansion and National ISDN-1."[54]

These passages all illustrate that the shortened life of digital switches is being driven by non-exchange services. When measuring the cost of universal service, the depreciation rates should either be based on the technological life of the equipment required for voice exchange service, or the profitability analysis should include the earnings from broadband digital and CLASS services. If the former option is selected, the Joint Board should consider basing the depreciation lives and salvage values for

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[51] NET 1993 Depreciation Rate Study, p.8.

[52] NET Rate Study, p.7

[53] NET 1993 Depreciation Rate Study, p.8.

[54] NET 1993 Depreciation Rate Study, p.8.

POTS on the mid-point values established by the FCC.[55]

B. Cost-of-Money

BCM2 currently uses an 11.25% cost-of-money, the rate adopted by the Federal Communications Commission a few years ago. The current interest rate on telephone bonds is 7.86%.[56] Assuming a 45/55 debt/equity structure, a composite 11.25% return is equivalent to a 14.025% return on equity. This level of return is quite high relative to the cost of capital determined in recent State regulatory proceedings. For instance, in March of this year, the Connecticut Department of Public Utility Control determined that 11.90% was the appropriate cost of equity.[57] The Joint Board should recommend a cost of capital that is in-line with the recent findings of the State Commissions.

C. How Many Loops are Eligible for a Subsidy

Presumably the Joint Board will recommend that the universal service fund be used only to subsidize one line at any given household. In order to comply with the Act's objective of technological neutrality, the subsidy should be portable. The subscriber should be able to apply the credit to any authorized local exchange operator that provides service in the high-cost areas. If the size of the fund is calculated by identifying those areas within a wire center in which the revenues are less than the cost-of-service, the subsidy should not be available to suppliers that serve only a portion of a wire center. The subsidy should only be available to suppliers that are serving high-cost CBGs, or whatever unit of analysis is adopted by the Joint Board.

It is sensible to subsidize only the primary line because that is all that is required to obtain access to the voice network. Second lines are often installed for fax lines or

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[55] These rates are summarized in Connecticut Department of Public Utilities, Investigation into the Southern New England Telephone Company's Intrastate Depreciation," Docket No. 94-10-03, November 21, 1995, pp. 23-24, and Table E.

[56] New York Times, October 10, 1996, p. D18.

[57] *Application of the Southern New England Telephone Company for Financial Review and Proposed Framework for Alternative Regulation*, Docket No. 95-03-01, p. 139, March 13, 1996.

for access to the internet. Separate lines for these services are not a necessity and therefore, should not be included in the universal service funding mechanism.

If only one line is eligible for a subsidy, the costing of the USF should reflect this policy decision. The utilization rate built into the model should reflect this policy objective. Fewer spare cable pairs are required if there is no need to provision the network for a second household line. If, on the other hand, a decision is made to subsidize more than one line per household, then the revenue from the second line should be included in the analysis, both revenues and costs for products should be treated in like fashion.

A third approach, and the one I recommend, is to provision the network for two lines to each household. The profitability analysis should then take into account the earnings from both lines. The advantage of this approach is that the Joint Board will not have to decide the appropriate level of spare facilities in a network designed for only single-line households. The adoption of this study technique does not conflict with a policy of providing universal service support for only one line.

D. Cost Allocation Requirements of §254k

The 1996 Telecommunications Act requires that "The Commission, with respect to interstate services, and the States, with respect to intrastate services, shall establish any necessary cost allocation rules, accounting safeguards, and guidelines to ensure that services included in the definition of universal service bear no more than a reasonable share of the joint and common costs of facilities used to provide those services." §254(k). Section 254(k)'s requirement is not limited to high-cost areas. Regardless of the cost-of-service, the law requires that the price of these essential services not be set to recover the total cost of joint and common inputs. This section of the law precludes the Commission from adopting policies that effectively require the recovery of 100% of the joint cost of the loop from exchange service. The universal service fund and/or the access fees must be designed to recover a portion of the joint and common costs of facilities as mandated by §254(k).

E. Revenue

The purpose of undertaking a cost study for universal service is to identify the cost of providing service to unprofitable areas. The cost data should be used in the same manner in which a business would use this information; cost data should be used to access the profitability of the relevant products. Areas should qualify for universal service support where the cost-of-service exceeds the relevant revenues, based on the funding requirements of §254(k).

The relevant revenues depend upon how the cost model has been constructed. As a starting point, if the cost of serving all customers is considered, including business subscribers, then the relevant exchange revenue is not limited to residential service. Both BCM2 and HM2.2.2 have been used to identify the direct and shared costs of business and residential service. Since costs that are not part of the direct cost of residential service have been included in the cost estimates, the revenue derived from business exchange service should also be included. The revenue from business lines is considerably higher than it is for residential customers. For example, in 1992 small business paid an average of $42 per month for single line service, while residential customers paid $18.66.[58]

Furthermore, both models includes costs that are incurred for the provision of vertical services. The investment for the central processors in digital switching machines enables the companies to provide such features as call-waiting and call-forwarding. Since the BCM2 and HM2.2.2 include all or most of the cost of providing these vertical features in their estimates of the cost of providing universal service, the revenues from these enhanced features should be treated in a consistent manner. To date they have not been; rather the focus has been on the revenue which has been derived from residential exchange service and the subscriber line charge.

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[58] Common Carrier Bureau: Industry Analysis Division, "Reference Book: Rates, Price Indexes, and Household Expenditures for Telephone Service," May 1993.

HM2.2.2 also appears to include system seven signaling functions in the cost of basic local service investment.[59] SS7 also enables carriers to provide the new family of CLASS vertical features. If the costs and expenses of providing CLASS services are included in HM2.2.2's USO estimates, then the revenue derived from these facilities should also be included.

When a subscriber is connected to the network, call revenue is derived on both outgoing and incoming calls. If the Commission maintains the common carrier line charge, the common carrier line charge revenue should be included in the profitability analysis. The CCL revenue should be included because the profitability of serving a customer in a high-cost area is also a function of access revenues. If the Commission eliminates the CCL charge, as suggested in its interconnection order,[60] some other mechanism must be adopted which satisfies the requirement of 251(k) that "universal service bear no more than a reasonable share of the joint and common costs of facilities used to provide those services." These revenues should be included in the profitability analysis. If these revenues are not considered, connecting carriers may be asked to pay twice for the same facility. That is, they may be required to pay for a portion of the common and joint costs through the access fee, and then a second time through their universal service fund contribution.

As demonstrated in my discussion of depreciation on page 50, the introduction of new vertical services has been an important factor in the reduced life of facilities. If the cost studies are based on the service lives associated with a non-POTS network, the revenue analysis should also reflect the profits earned on these new services, products that may be sold in competitive markets. To do otherwise would violate the cost allocation standards established in §254(k). The cost of these network upgrades can not be assigned and recovered totally from universal service products.

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[59] Michael Pelcovits and Joel Lubin responses to the Federal-State Joint Board's request for information, August 26, 1996.

[60] In the Matter of Implementation of the Local Competition Provisions in the Telecommunications Act of 1996, CC Docket No. 96-325 and 96-98; and *Interconnection between Local Exchange Carriers and Commercial Mobile Radio Service Providers,* CC Docket No. 95-185, First Report and Order, Adopted: August 1, 1996, Released: August 8, 1996, paragraph 31.